Backwards Unit Planner

CONTEXT

1) Who is in your classroom? Describe the context within which the unit will take place. Describe the demographics of the class, the assessed needs that will be addressed within the unit, and the larger learning objectives within which the unit is situated.

This unit is designed for two periods of ninth grade Biology. Period 2 has 35 students, 10 of whom are categorized as English language learners. Two of those English language learners are new arrivals with no previous schooling. 15 of the students in Period 2 have an IEP. Period 3 has 35 students, and none of them are categorized as English language learners. 10 students in Period 3 have an IEP. Because these students are all ninth graders, we don't have much data on their reading levels. However, during previous reading lessons, the students have struggled with organization and comprehension. Part of the objective with this lesson is to assess their abilities with regards to literacy focused assignments.

CENTRAL FOCUS

2) Enduring Understanding (Purpose & Engagement)

Why does this unit matter? Why will your kids care? What will make them excited to come to school every day and tackle this unit?

Most of the students in my classroom are interested in the ways in which science and "real life" intersect - that is, areas like argumentation. Understanding what constitutes reliable information and how to use reliable information to make claims is a science and engineering practice that students can take into the lab or more generally just into their lives, into their discussions with those that they disagree with or would like to know more about. Using zombies as an initial hook into this unit is obviously an interesting one because most students have familiarity with zombies and can connect it to an experience they've had before. Taking it from zombies into biological macromolecules can seem like a bit of a leap but areas like scientific discoveries and nutrition provide great jumping-off points because they are, for the most part, relevant to students' lives.

3) Essential Questions

Essential questions are authentic, have no easy answer, stretch students' intellectual muscles, and ignite students' imaginations.

How do we know what we know in science? How do we make good arguments? How do we evaluate whether the information in a text is reliable or not?

4) Content Knowledge

What are specific concepts that you want students to learn through the unit? Why is this content knowledge important? How will students use this content knowledge to develop enduring understanding?

Students should come away understanding how to use evidence to create an argument, using various methods to construct it - both more highly scaffolded and less so (graphic organizer vs claim-evidence-reasoning passage). This content knowledge is important because using evidence to generate knowledge and beliefs grounds students in reality and helps them understand how "real scientists" construct knowledge.

5) Language Function

Identify one language function essential for students that is associated with the content objective. Describe what students need to understand and use in regards to vocabulary and syntax or discourse.

Students should understand what constitutes an evidence-based argument and how to create one from information provided in a complex text.

6) Skills and Strategies

What reading, writing, problem-solving, critical thinking, presentation, or collaboration skills will be addressed in this unit? How will these skills be addressed? What growth do you expect to see in students as a result of targeted instruction in these skill areas during the unit?

Argumentation is a key skill that this unit aims to develop in students. I hope to see students go from generating one in a highly scaffolded activity, to generating one more independently directly related to the information they've found themselves, instead of information I've provided for them.

7) CCSS

What elements of CCSS have informed this unit? How are these elements connected to the objectives stated above? How will they learn them?

Standards/Frameworks: CCSS Science & Technical Subjects

CCSS Standard	Connection to objective?	How will they learn it?
CCSS.ELA-LITERACY.RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.	Students must learn to cite specific textual evidence in order to create an evidence-based argument	During the Macromolecule Menu activity, students create their own lunch menu using information they have learned in class to provide evidence for their claims
CCSS.ELA-LITERACY.RST.9-10.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.	Students must be able to read a text and identify its core idea in order to determine whether the text will provide evidence to support to reject their claim	During the DNA Discovery activity, students read an article concerning the discovery of DNA and fill out a note-catcher that asks them to identify the main ideas and why they believe that

THEORETICAL FOUNDATION

8) What theories have informed this unit? Be sure to reference specific course readings.

This unit has been informed by two main chapters in Best Practices in Adolescent Literacy Instruction by Hinchman and Thomas: Ch. 12 *Reading Challenging Texts in High School: How Teachers Can Scaffold and Build Close Reading for Real Purposes in Subject Areas* and Ch. 4 *Using Discourse Study as an Instructional Practice with Adolescents to Develop 21st Century Literacies of Critically Conscious Citizens*. The goal of this unit is to help students understand how reading can help them become more informed citizens and people through argumentation and evidence-based practice. Moje

& Speyer point out that "young people read many different kinds of texts - including challenging texts - outside of school", but that the key to their persistence through difficulty is "that these texts are embedded in meaningful social networks" (Loc 4288). This research suggests that creating a class culture that values evidence-based argumentation (which requires reading complex texts) and gives students opportunities to engage with their peers socially in application of those skills helps to motivate students to persist despite challenges. Of course, learning to advocate for a claim using evidence from text involves a host of other implicit rules and guidelines that can be described as "discourse", or the way that the dominant culture (that is, the one of school) "organizes and constrains thoughts, words, and actions" (Hagood, Loc 1450). When teaching a unit like this one, it is important to be explicit about the rules guiding the students' communication without assuming everyone is already on-board. The instructor must be honest about why the discourse of the dominant culture is being taught (it will bring opportunities to students in the future to be able to communicate this way) while still valuing and drawing from the students' own discourse to bridge the two where possible.

EVIDENCE OF UNDERSTANDING/ASSESSMENT

9) ***Pre-Assessment:*** *How will you assess whether the students you are working with have the ability to perform the core academic skill(s) prior to beginning your lesson?* ***(See page 2 of UDL Differentiation Plan)***

Students complete quick-writes and think-pair-shares prior to every lesson in order for the instructor to assess informally where they are at in the unit. During every activity, the instructor visits the small groups and ensures using probing questions and individual instruction that students are understanding the task at hand and its reasoning.

10) ***Formative and Summative Assessments:*** *How will you assess what students are learning? Please list at least two assessment measures that you will use during your unit. Be sure to include specific prompts, activities, rubrics, or other assessment measures as well as samples of student work.*

(Please include at least two of the following)

a. Informal checks for understanding

Students will turn in their DNA Discovery note-catcher, which will act as an informal check in that the instructor can see the students' thought processes in describing the main idea. The DNA Discovery activity also involves a gallery walk, after which the instructor can read all of the students' responses to assess their thinking. In The Science of Zombies, the students present their claims and the evidence used to justify them to the instructor as an informal check for understanding. Students also turn in their graphic organizer for The Science of Zombies at the end of the activity.

b. Quiz or test

c. Performance task

In the Macromolecule Menu activity, students are asked to create a school lunch menu and a claim-evidence-reasoning paragraph that describes and justifies their choices for the menu. This serves as an assessment of their abilities to use evidence to justify their arguments.

LEARNING EXPERIENCES

11) ***Introductory activities*** *- What activities will you use to "hook" the students into the unit? How will these activities introduce the big ideas and essential questions? (Be sure to explain how the activities respond to student interest and background knowledge. Also, please include "kid appropriate language" that will be used, as well as any sample prompts, simulation activities, questions, texts, movie clips, etc. that will be used.)*

All of the lessons involve a quick-write that asks students for their opinions on big questions - what do they think, and why? Then students are generally shown a multimodal introduction to the topic and asks to do a think-pair-share afterwards to discuss whether their opinions have changed. These types of activities encourage students to engage in metacognition: how are they forming their opinions, and if shown evidence to the contrary, are they adjusting their opinions? Why or why not? All possible video options are linked in the corresponding lesson plans.

12) ***Instructional activities*** *- What instructional activities will take place during the unit? (Be sure to include a range of activities that may include opportunities for direct instruction, student discussion, inquiry learning, text analysis, individual application, group exploration, etc.)*

The Science of Zombies - Students are to read an article in groups using reading roles, and then come up with three items they would grab from a shopping mall in the event of a zombie apocalypse. They must justify their choices using evidence from the text, in the form of a quote or paraphrased section.
DNA Discovery - Students are to read an article about the discovery of DNA from Newsela individually and fill out a note-catcher that asks them to find the main idea. Afterwards, they participate in a gallery walk that asks them to respond to questions about the article such as, "Do you think Rosalind Franklin was fairly treated during this scientific process?" and "How has this discovery impacted science, in your opinion?". Each student must write at least one post it during the gallery walk and respond to at least one of their classmates.
Macromolecule Menu - Students fill out a graphic organizer about nutrition and biological macromolecules and then come up with the best school lunch menu, according to what they've learned. They must write a claim-evidence-reasoning paragraph that uses evidence to justify the foods they've chosen.

13) ***Reflection activities*** *- What metacognitive opportunities will be included for student reflection? (Be sure that students have multiple opportunities to revisit and reconsider their responses to the big ideas and essential questions of the unit. Include specific prompts as well as a description of how the prompts will be used.)*

The anticipatory set for every activity is a reflection on what they know and why that think that. Since every activity is created to be done in small groups, the instructor has ample time to walk to each group and ask probing questions about why students have chosen a certain path or not - this encourages students to think about their choices and justify them. For the Science of Zombies lesson, students present their choices directly to the instructor, which provides direct assessment and helps students better understand where they may need to improve.

14) ***Anticipated schedules*** *- How will you sequence your 3-day unit? (Briefly outline each lesson within the unit, including specific objectives of that lesson, the activities that will be included in that lesson, the assessments that will measure student learning*

during that lesson, and the pacing of the lesson.) Please attach lesson plans for each of the 3 days.

DIFFERENTIATION & ACADEMIC LANGUAGE

15) ***Differentiation*** *- How will my lesson satisfy the needs of all learners, including IEP, 504 plans, high ability learners, etc.? Add rows as needed.*

Students with IEPs/504 Plans

IEP/504 Plans: Classifications/Needs	Number of Students	Support, Accomodations, Modifications, Pertinent IEP Goals
Several students in the classes have IEPs for dyslexia, several have ADHD, one has tourettes	~25	Extra time can be given for every assignment, and scaffolded individual instruction can be given as needed during small group practice

Students with Specific Language Needs

Language Needs (ELL)	Number of Students	Support, Accommodations, Modifications, Pertinent IEP Goals
Two students are new arrivals, with very limited English proficiency, the rest are socially proficient with needs for scaffolding academic English	~12	For the two students who are new arrivals, bilingual peers are used to help, and they use translation apps to aid. Individual instruction during small group practice is also used. For the other students, they are to underline vocabulary they don't know and ask their peers or the instructor during small groups

Students with Other Learning Needs

Other Learning Needs (high ability, struggling readers)	Number of Students	Support, Accommodations, Modifications, Pertinent IEP Goals
There are a few students who require extra challenge otherwise they will disengage	~10	Readings for extra credit, as well as challenge questions, are provided in all of the lesson plans. These students can read and summarize an academic article or answer deeper, more challenging questions

16) ***Scaffolding for Equity*** *- Identify a few students whose needs you'd like to be intentional about meeting. How will you differentiate for students with special needs? Consider both* ***access*** *and* ***challenge****.*

Student	Task	Scaffold/Support/Challenge
Special Needs/IEP: Student A	Filling out the DNA Discovery note catcher	This student has an IEP for dyslexia, and generally struggles with reading activities. During this activity, the instructor can spend extra time with this student modeling how to glean main ideas from text
English learner: Student B	The Science of Zombies graphic organizer	This student generally prefers oral communication rather than written, so the instructor can encourage him to be the main presenter during this activity and to take on more responsibility in that regard
Ready for challenge: Student C	Macromolecule Mene article summarization	This student often gets off-task if he is not properly challenged, and he has a very curious nature who is interested in asking hard questions. The instructor would offer this student to summarize and give his opinion on an academic article regarding nutrition during this activity

REFLECTION

17) *How did this unit evolve during your planning process? What influences shaped your unit? What did you learn as a result of your planning? What do you feel are the strengths and weaknesses of your unit? (References to course readings are encouraged.)*

Creating a unit based on literacy in a ninth grade Biology class at first seemed quite challenging to me, if only because while scientific literacy is crucial, often literacy-based assignments don't make up the majority of lessons in a Biology unit. In my practicum classroom, the students do very little reading as part of curriculum, and almost never do wholly reading-based activities. I was unsure of how the students would react to a change in pace of that nature, but curious as to what a literacy-focused unit would look like. I decided to focus on argumentation and use of textual evidence as that felt like a natural fit in a Biology curriculum, and I think it is an interesting and important topic for students to engage with. I chose biological macromolecules as my topic for my Methods unit plan, so it felt natural to choose topics within that sphere for this unit as well. This topic felt, at times, difficult to use because it isn't as disposed to interesting or controversial narratives as some other concepts in Biology, such as ecology or evolution. However, I am happy with my choices and I think that using the discovery of DNA and nutrition as jump-off points for argumentation work really well. As Tatum notes in *Texts and Adolescents*, "classroom environments and curricula are not often structured to shape students' lives by engaging them with texts that they find meaningful" (Loc 309). It meant a lot to me to find articles and narratives that relate to students or to issues that are important. I wanted to avoid simply reading for content, but instead to focus on reading in order to glean some greater knowledge about how the world

works. The discovery of DNA is an insight into bias and prejudice within science, how scientific discoveries are often misattributed to individuals when they are actually collaborative group efforts, and how the power dynamics of a culture shape the narrative that gets proliferated. These are issues that we still grapple with today. Ideally, "educators can use texts to broker positive relationships with adolescents and connect students to something important that will lead to different actions and thinking beyond the reading event" (Tatum, Loc 329). Choosing texts and concepts that students are able to take into their lives outside of the context of Biology increases the chance that these students will engage with the material. I think it is just a question of whether these grand themes are communicated effectively in my lesson - that is, do students understand the larger goals this lesson has for them. I think the choice of text is a strength of my unit, but I think a weakness could be a lack of whole class discussion besides the gallery walk in DNA Discovery. I also think that while The Science of Zombies is a great introductory activity, it could be more connected to the other two lessons in the unit. That was a limitation of having to teach the lesson - we weren't doing macromolecules at the time in my practicum class, and I wanted to assess how the students would react to a reading-based lesson using something more light hearted.

INSTRUCTIONAL MATERIALS

18) What instructional materials were needed to implement the lesson? (Materials may include readings, problem sets, graphic organizers, discussion prompts, written reflection prompts, group work organizers, assessment rubrics, etc. ***Materials should be prepared so that they are ready for classroom use.****)*

Dates of Unit/Instruction: Nov 1, 2019
Lesson Objective: Students use textual citations from the article "The Science of Zombies" to justify claims made about tools they'd bring with them into a zombie apocalypse with evidence.

What will students walk away with from this lesson?

All Students This includes students with IEPs, 504s, SSPs, ELLs	**Most Students** The majority of students in your class	**Some Students** Students who need or want an extra challenge
The knowledge that citing textual evidence to support a claim makes the claim stronger, and allows others to understand your reasoning better	The ability to cite text using quotes and paraphrasing in order to justify a claim made in a scaffolded graphic organizer	The ability to use several different textual citations embedded within your writing in order to create a narrative about your claim and its justification

Differentiation Plan

Complete this graphic organizer as you think about the lesson you chose.

Differentiation of:	How will you differentiate within this lesson:
Materials ***Things to consider:*** • ***Levels*** • ***Multimodal means*** • ***Tools (manipulatives, highlighters, audiobooks, etc.)*** • ***Type of graphic organizer***	- Multiple colors when modeling annotation, highlighters, and modes of marking (stars, underlining, etc) - Small group instruction to maximize flexibility & individual instructor attention - The instructor can alter certain students' graphic organizer to add more direction if necessary
Instruction ***Things to consider:*** • ***Grouping*** • ***Check-ins with specific students*** • ***Question types*** • ***How content is delivered***	- Graphic organizer scaffolds activity so that students know exactly what is expected - Videos can be used for multimodal presentation - A mix of whole class and small group instruction - During small group instruction, instructor can move around to students for check-ins
Assessment ***Things to consider:*** • ***Pre-test*** • ***Post-test*** • ***Informal*** • ***Alternative demonstration of knowledge***	- During small group instruction, instructor can visit each group for informal assessment throughout activity - Students both write and orally present the information, allowing them to elaborate in whichever mode they find best for them
Instructors ***Things to consider:*** • ***Academic coaches*** • ***SpEd teachers***	- Cooperating teacher and myself operate in "one teach, one assist" mode - Generally, I deliver instruction and we both visit groups during small group practice

• ***Speech therapist, other service providers*** • ***Students***	- The instructor can assign bilingual peers to work with ELL students who are in particular need of translation

Differentiation Plan - Building a Differentiated Lesson

Purpose: Build a lesson where you will be splitting students into small groups. Next, implement differentiated strategies of your choice in order to make sure all students are obtaining the core academic skill you hope to instill within them.

Core Academic Skill(s) (all students, most students, and some students):

Develop the knowledge that citing textual evidence to support a claim makes the claim stronger, and allows others to understand your reasoning better	The ability to cite text using quotes and paraphrasing in order to justify a claim made in a scaffolded graphic organizer	The ability to use several different textual citations embedded within your writing in order to create a narrative about your claim and its justification

How will you deliver the core academic skill(s)?

The students will be reading the article "The Science of Zombies" and will use evidence from the text to develop claims about which tools they'd bring with them into a zombie apocalypse.

Pre-Assessment: How will you assess whether the students you are working with have the ability to perform the core academic skill(s) prior to beginning your lesson?

A quick-write warm up will ask students to respond to this question, "Do you think zombies are scientifically possible? Why or why not?" This video is shown to pique students' curiosity into how symptoms of "zombie-ism" can be based in scientific reality. Students do a think-pair-share about whether their response to the warm-up changed after watching the video. The why or why not portion is emphasized - did they include evidence for their why, and if they didn't, why didn't they?

Creation of a Differentiated Lesson

Reminder #1: Incorporate some form of small group instruction.
Reminder #2: Create a graphic organizer! Additional modified organizers may be needed in order to access all students.

What will I be doing?	What will the inclusion specialist and/or academic coach be doing?	What will the students be doing?	What differentiated strategies will I be putting in place?
- Delivering instructions orally	- Observing during	- Reading the text using reading	- Content is scaffolded/chunke

and via writing - Modelling tasks expected - Break students into mindful and heterogeneous small groups - Visiting each small group to ensure understanding - Checking in with students who need more assistance - Assessing student work with them so they understand explicitly what they need to do to improve	instruction delivery - Visiting each small group to ensure understanding	roles modelled - Taking turns summarizing/questioning as their role requires - Deciding which items to take with them and filling out graphic organizer with their justifications	d in graphic organizer so that students can access the information - Small group instruction helps maximize one-on-one student/instructor interaction

Post-Assessment: How will you assess whether the students you are working with have the ability to perform the core academic skill(s) at the end of your lesson?

Once students have finished choosing their items, they present their chosen items to the instructor. The instructor gives necessary feedback, such as asking students to provide more evidence or clarification on the reasoning. If the evidence provided for the items is suitable, the instructor checks their organizer and the students turn it in. This presentation allows the instructor to assess the students and the students to know exactly where they may need to improve.

Resources

Overview of Reading Instruction

Small Group Instruction

- Small Group Instruction
- Small Group Instruction (SQ3R Method)
- Small Group Instruction: 4 Tips to Remember
- Small group instruction in math (this is written with math in mind but can also apply to other subjects)
- Guided Reading Activities

Reading & Vocabulary Strategies

- Text Comprehension Strategies
- 25 Reading Strategies
- Dyscalculia Strategies
- Math Vocabulary Strategies

Assessment

- Differentiated Assessment
- Differentiated Assessment

- More Assessments

Differentiation of Instructors

- Co-Teaching
- Co-Teaching -- How To Make It Work

Graphic Organizers

- Types of Graphic Organizers
- 10 Graphic Organizers

General Accommodation Ideas

- List of strategies to support different areas (inattention, organization, reading, etc.)
- Differentiated Instruction (with checklist) (this article includes strategies for differentiating learning environment, activities, presentation, resources/materials, and assignments or assessments. It also includes a planning guide/checklist.)
- How to differentiate in the Science classroom
- Designing Lessons for Diverse Learners
- EL Strategies
- More EL Strategies
- EL Strategies-Best Practice

The Science of Zombies UDL Lesson
Designed By: Corinne Webb, 2019

Class Analysis
Grade Level: 9th grade
Subject: Biology

Learners	Levels/Assets	Interests/Strengths	Needs: EL (CELDT/ELPAC), IEP, 504, GATE
This lesson is designed for two periods of ninth grade Biology. Period 2 has 35 students, 10 of whom are categorized as English language learners. Two of those English language learners are new arrivals with no previous schooling. 15 of the students in Period 2 have an IEP. Period 3 has 35 students, and none of them are categorized as English language learners. 10 students in Period 3 have an IEP.	Because these students are all ninth graders, we don't have much data on their reading levels. However, during previous reading lessons, the students have struggled with organization and comprehension. Part of the objective with this lesson is to assess their abilities with regards to literacy focused assignments. Specifically, this lesson is designed to measure their ability to use evidence to make an argument.	The students in Period 2 have developed a strong sense of community within their groups and seem to prefer small group instruction to whole class. Period 3 has developed a strong whole-class community and they enjoy whole class discussions, and are much more willing to share in those environments. Every student was excited for Halloween and some even dressed up for school, so I knew that doing a Halloween themed assignment would be interesting to them.	Period 2 is a designated ELL class, so many of those students are English language learners and two of them are new arrivals with traumatic migration experiences. Period 3 is a more typical intro Biology classroom with varying levels and 10 students with IEPs.

Support People	Technology	Supplemental Materials	Resources
This lesson is designed to be done in small groups, with a short presentation to the instructor as a formative assessment	Smartphones, Chromebooks	The Science of Zombies, TSOZ Graphic Organizer, Pen/pencil	This video that delves into the history of zombies can add historical context, this video is a visual representation of the article's content

Place in Unit: This lesson is designed a small one-off activity to assess students' comfort with literacy based assignments, it should take place near Halloween for increased relevance and engagement from students
Measurable Objective: Students create an argument to justify items they'd choose for a zombie apocalypse by gathering and using at least three pieces of data from the article "*The Science of Zombies*".
CCSS Standard: CCSS.ELA-LITERACY.RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

Lesson Segment	Materials	Sequence of Lesson	Instructional Strategies	Inclusive Practice to Support All Learners
Anticipatory Set (5 min)	SmartBoard, sheet of paper, pen	A quick-write warm up will ask students to respond to this question, "Do you think zombies are scientifically possible? Why or why not?" This video is shown to pique students' curiosity into how symptoms of "zombie-ism" can be based in scientific reality. Students do a think-pair-share about whether their response to the warm-up changed after watching the video.	The quick-write gets students to think about the topic at hand in a way that encourages every student to share, the video diversifies modes of instruction so as to be more engaging, think-pair-share allows students to formulate their thoughts with peers before sharing	Think-pair-share enables all students to share, even those who may require more time than others. Video allows visual aids for ELL students.
Instruction (10 min)	The Science of Zombies, graphic organizer, pen	Hand out The Science of Zombies article, explain to students that they will form groups of 3-4 and take on roles during the reading of this article. Every student reads a section, then one student acts as the summarizer and explains the main points of that section. Another student will act as the questioner, asking any clarifying questions to the summarizer. They then trade roles and continue reading, section by section, until they reach the end.After they finish reading the article, the instructor gives them the graphic	Frontloading information about the graphic organizer helps students focus and organize their thoughts onto the information necessary. Reading roles enable the students to be more mindful about how they are collecting and processing the information presented in the article.	Frontloading information helps students focus who may have otherwise had a difficult time. Roles allow students to be peer mentors and the questioner allows any gaps to be filled. Peer groups can be mindfully created to ensure that heterogeneous student groups are represented.

		organizer in which they will list items they'd pick if there was an impending zombie apocalypse. The instructor will only hand the group the organizer when they are finished reading the article.		
Guided Practice (7 min)	The Science of Zombies, graphic organizer, pen	The instructor can model the group reading dynamic with a group for the class. The instructor will also walk around to each small group and give individual instruction, ensuring that students are using the facilitating roles and gleaning accurate information from the text.	Modeling the reading roles helps students understand what is expected during the reading.	Modelling aids ELL students in understand the expectations better than if the instructions were just given orally.
Independent Practice (20 min)	The Science of Zombies, graphic organizer, pen	After students confirm with the instructor that they are finished reading the article, the instructor can give them the graphic organizer. The students, in their groups, must choose items and use evidence from the text to justify their decision.	The graphic organizer helps to make explicit what is sometimes implicit in writing - that they must use textual evidence to back up their claims. This scaffolds the process so that later they can make evidence-based arguments without being explicitly asked to provide evidence.	Peer groups can be mindfully created to ensure that heterogeneous student groups are represented. Small group instruction maximizes group learning.
Closure (8 min)	The Science of Zombies, graphic organizer, pen	Once students have finished choosing their items, they present their chosen items to the instructor. The instructor gives necessary feedback, such as asking students to provide more evidence or clarification on the reasoning. If the evidence provided for the items is suitable, the instructor checks their organizer and the students turn it in.	Instructor probing questions allow the students to construct knowledge in a way that both provides the instructor with a formative assessment, and aids the student in metacognition.	Grading projects in real time allows students to understand better how to improve - generally the instructor can do a "pre-grade" where you look the project and let students make any improvements needed before actual grading.

THE SCIENCE OF ZOMBIES!

Only those prepared and armed with the right knowledge will survive the zombie apocalypse.

They have captured the imagination for years, though what they really want to do is capture your brain. Don't get too exultant if you manage to chop off their arms or legs. Oblivious to pain and ravenous, they will tirelessly advance without thought to any lost appendages. What are these foul creatures!?

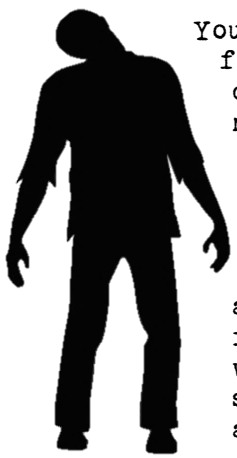
Zombies! Or more descriptively described as reanimated brain-hungering corpses. Mindless, lumbering and voracious; they are the stuff of nightmares, but what do we really know about them? Let's find out.

DON'T LET THEM BITE YOU WHILE YOU BARBEQUE!

Depending on the type of zombie you're facing, there are various ways that they can turn you into one of them: through a painful bite or an unlucky scratch, through invisible airborne infection or even through insidious parasitic invasion. Hmmm...is there any truth to this? Can we compare any other creatures that employ such dastardly methods of contagion in the natural world?

Imagine that you are minding your own business in the backyard. You might be gardening, sunbathing or having a barbeque on a Sunday afternoon. Suddenly, a violent and senseless creature drags itself out of the woods and bites you. You have been infected and soon you will also become a mindless senseless creature. Zombie attack?! Yes... possibly, but this modus operandi is also employed by rabid animals infected by the rabies virus.

Rabies is a viral disease that infects warm-blooded mammals. It can be found in their saliva, and hence a bite can cause transmission. Once you get infected, if left untreated, the rabies virus will crawl along your nerves until it reaches the prize...your brain, at which point alterations in your brain anatomy and function will begin to occur. This will lead to encephalitis. From the Greek enképhalos means "brain" and the suffix –itis means "inflammation".



Your damaged brain will cause you to exhibit violent behavior, you will feel agitated as well as have fits of abnormal excitement and confusion. As your brain is overcome by the virus, you will become more aggressive. Hmmm...sounds suspiciously like a zombie. There are two strains to the rabies virus. One is called *furious* and one is called *dumb*. If you are infected by the *furious* virus you will become easily angered and exhibit extreme aggressiveness. These also happen to be the typical zombie symptoms. However, if you are infected by the *dumb* virus, you will become paralyzed, withdrawn and fearful. If there are *dumb* zombies, they never make it on T.V. or in the movies. Once bitten, you become a zombie within minutes but with rabies, it takes several weeks to show signs of the illness and spread the disease. This explains why we won't have a rabies apocalypse, but a zombie apocalypse is almost guaranteed.

Interestingly, during the later stages of rabies, hydrophobia can develop. Hydro- means "water " and -phobia means "fear". Imagine being extremely thirsty, but too afraid of water to drink it. Why would this happen? Since the rabies virus can accumulate in the saliva, infected victims will salivate more, creating that classic "foaming of the mouth" effect. If victims constantly sought out water for drinking, this would wash down the saliva and setback the ability of the virus to effectively transmit itself. Though it is not known if zombies exhibit hydrophobia, very few, if any zombies have been observed reaching for the tap or for a bottle of Perrier.

ARE BRAINS REALLY THAT DELICIOUS?

No one in their right mind would eat brains, would they? Cannibalism has been well documented in human history. Many cultures have used cannibalism in ritualistic as well as in nutritive ways, though the former is far more common.

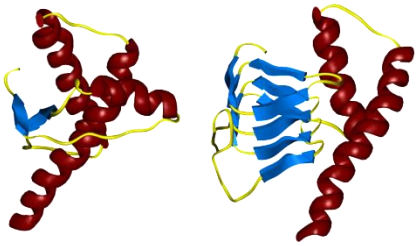
The Fore people of Papua New Guinea have a ritual of mortuary cannibalism, meaning that when a loved one dies, they prepare the body so that the internal organs will be eaten by family members during the death rites. This is to show respect and to return the "life force" of the relative back to the community. Brain morsels are often given to the children, women and the elderly of the tribe.

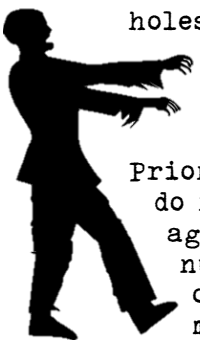
In the 1950s, the Fore people began noticing that members of their tribe would begin to have strange symptoms of shaking and body tremors. They called this "kuru" which comes from the Fore word "kuria" which means "to shake". Because members afflicted with kuru would also burst into fits of delirious laughter, they also called this "laughing sickness".

It turns out that all this brain eating wasn't only transmitting life force throughout the community, it was also spreading an infectious degenerative brain disease caused by a prion.

Prions are abnormal proteins in the brain that are not shaped properly because they are incorrectly folded. The key to the functioning of all proteins is their correctly folded shape. When prions come into contact with healthy proteins, they cause them to fold incorrectly as well. It's like playing tag. "You're it!...now you're a prion too." Every new prion can go on to convert many more healthy proteins into diseased ones in an exponential pattern. As this happens, holes begin to develop in the brain that result in decreased muscle control, impairment of speech, loss of voiding functions, uncontrolled laughter and emotional instability.

<u>normal protein</u> <u>abnormal protein</u>

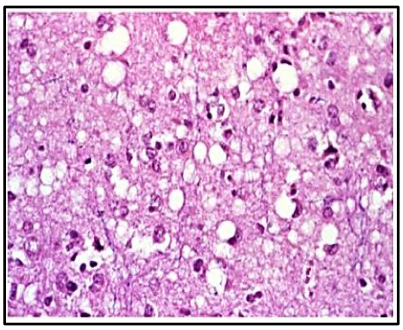




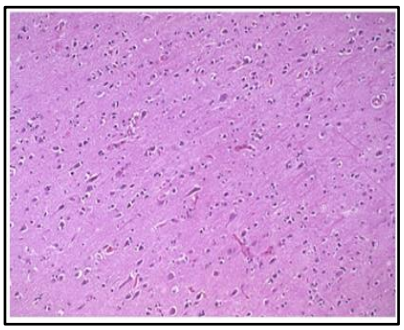
Prions are unique because they are the only known infectious agents that do not contain any nucleic acids (DNA or RNA). All other infectious agents – viruses, bacteria, fungi and protozoan parasites require nucleic acids to make more of themselves. Prions just need to touch other proteins to transform them and hence they replicate in this manner. Prion diseases are incurable and have a 100% mortality rate.

Besides kuru, there is also another prion disease called Creutzfeldt-Jakob disease (CJD) which has been transmitted during operations with prion infected materials and medical instruments (e.g. during corneal grafts, dural grafts and electrode implantations into the brain) as well as through the consumption of beef that is contaminated with the prion that causes bovine spongiform encephalopathy (BSE) or more infamously called "mad cow disease". All prion diseases degenerate the brain and leave the brain tissue riddled with holes.

CJD brain tissue



normal brain tissue



"...reanimated brain-hungering corpses. Mindless, insensible, lumbering and voracious... "

Brains, brains, brains. Prions love them and so do zombies. Zombies definitely show signs of brain dysfunction. Just look at their lack of fashion sense and you can tell that something is not quite right up in the ole brain case. Could they be consuming healthy brains to make up for their diseased ones? Hmmm...

THE MISUNDERSTOOD ZOMBIE

We can think of zombies as monsters, but could zombies be misunderstood victims of brain damage? Let us try to shine a charitable light on a zombie's seemingly ruthless actions.

So your grandma has just been turned into a zombie. You've always been her favorite grandchild and she would always sneak you treats when no one else was looking and give you the best hugs. She would love to read to you when she visited and listen attentively to your stories about school and how your day went.

Today will not be one of those days. Your newly reanimated grandma zombie lurches towards you with outstretched arms. You suspect it isn't for a hug this time. Her once sweet voice has turned into a mumble of garbled sounds. You say "Grandma...it's me...don't you recognize me?!" She ignores your words completely and doesn't recognize you. She opens her mouth to form a word and through a throat that seems full of rust and nails you pick out the word..."brains". You stumble backwards as she advances and you knock over a cup of milk on the table behind you. This seems to send her into a rage and she lunges forward. You pick up one of the dining table chairs and hold it above your head. "Grandma...I don't want to hurt you." Grandma zombie doesn't seem afraid of your threats and moves towards you relentlessly. You put down the chair. It's time to run.

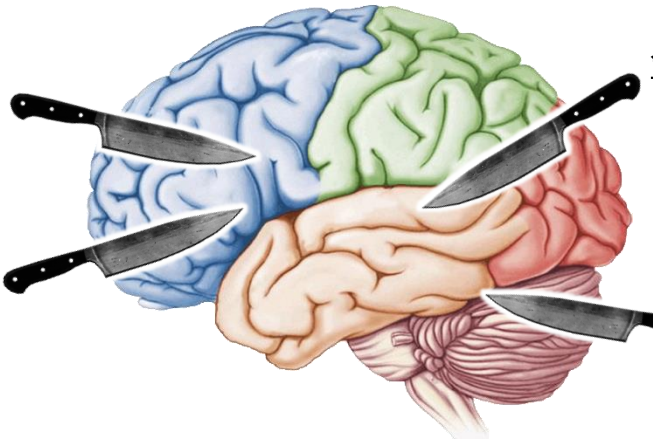
DEMON OR DISABLED?

Has grandma become a monster? Could there be another explanation? Let's go through some of the facts. She can't seem to form words properly. The area of the brain responsible for forming words is called Broca's Area in the frontal lobe. Broca's area is responsible for speech formation so damage to this part of the brain impairs speech production.

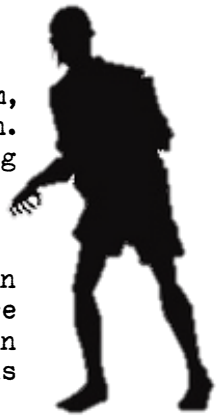
She also didn't seem to recognise your words when you spoke to her. Wernicke's Area, located in the parietal lobe, is responsible for understanding language. You might be saying "Grandma...it's me...don't you recognize me?!" but she might be hearing, "Don't you think my brain is mouth-watering?".

As well, there is an alarming lack of warmth and affection shown by zombie grandma. Has she become a hostile force, or again, is she a victim of brain damage? There is a condition called prosopagnosia, also known as face blindness, that prevents people from recognizing the familiar faces of others. Because they can't recognize people, they cannot attribute emotional connections or understand a shared history between themselves and other people. This is caused by damage to the fusiform gyrus of the brain that is shared between the lower halves of the occipital and temporal lobes.

What about her anger towards the cup of milk you knocked over? The grandma you know would never have flown into a rage over something so trivial. Why is grandma zombie so angry? There's an area of the brain called the amygdala which is responsible for controlling aggression and anger. It is also responsible for controlling the fear response. Your grandma showed no fear towards your threat of hitting her with a chair. Both her extreme hostility and her lack of fear are good signs that she has impaired amygdala function.

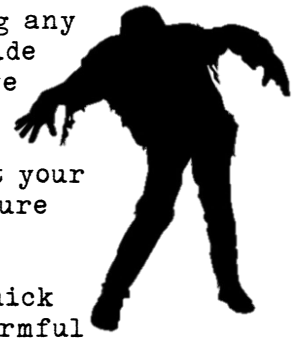


GO AHEAD AND CHOP OFF MY ARM!



Why is it that a zombie continues to shuffle onward even after an arm, leg or nose has been lopped off? It is because they don't feel any pain. This certainly serves them well as many zombies seem to lose limbs during their misadventures. Is this insensitivity to pain unique to zombies? Can living humans also exhibit this trait?

A rare genetic disorder called CIP or congenital insensitivity to pain has been scientifically documented in around 20 individuals. They are born with a mutation that creates an inability to form the vital protein channels needed for nociceptors to function. Nociceptors are nerve cells that transmit pain signals to the brain.



In most cases this may seem like a dream come true, but not feeling any pain is actually a distinct disadvantage. Imagine biting the inside of your mouth and not noticing it, having something enter your eye and not feeling it, cutting your hand with a knife and not wincing at the sting or fracturing a bone and not sensing it. This may seem great, until you've chewed your mouth to shreds, lost your eye, developed a festering wound in your hand and have that fracture turn into a full break. All these things can result from CIP.

Many people with CIP have shorter life expectancies. Pain is a quick and effective teacher. It teaches you to be wary of physically harmful scenarios. Since pain is unpleasant, we will learn to avoid that which causes it. This teacher is absent in people with CIP. This teacher is also absent in zombies. Both people with CIP and zombies will forge ahead in dangerous situations because they won't be concerned with the physical consequences. In CIP patients, this can lead to their death due to unnoticed physical damage to their body. In zombies...well...they just truck on.

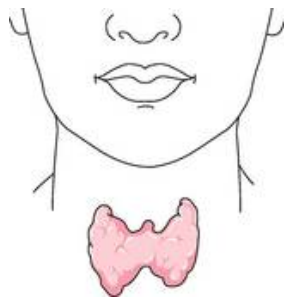
WHEN A BUFFET OF BRAINS IS NOT ENOUGH!

A zombie's main job is to menace the remaining survivors of a zombie apocalypse as well as to seek out and consume as many brains as possible, but when do they get to enjoy any leisure time? It seems like they are constantly seeking out warm gooey brains to eat. Why don't they just stop once they've had a civilized portion of brains? Why are they so insatiable?

Would a human act like this? Do you know people that are able to eat whatever and however much they want and yet remain as thin as a rail? Are they the plague of buffet restaurants? These people might even complain of hunger after eating a meal that would feed a small family. What's wrong with them? Are they in any way related to their ravenous brain-loving undead counterparts?

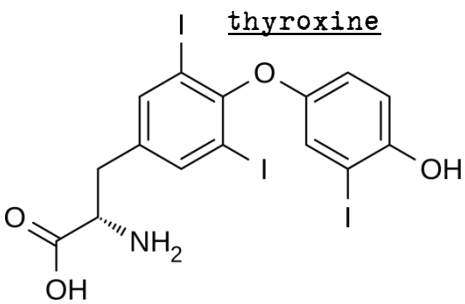
HERE ARE TWO POSSIBILITIES:

thyroid gland

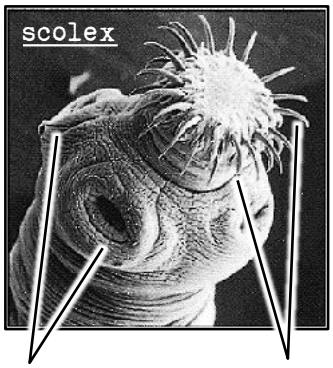


1) THEY SUFFER FROM HYPERTHYROIDISM. In Greek, "hyper" means over or excess. In hyperthyroidism, the thyroid (a gland located in front of your throat) produces an excessive amount of one or both thyroid hormones, thyroxine and triiodothyronine. They are hormones that regulate metabolism. Having these hormones in excess can lead to increased metabolic rate and a greater requirement for fuel (from food) by the cells of the body. For this reason, people suffering from hyperthyroidism may be constantly hungry. Could zombies have an overactive thyroid?

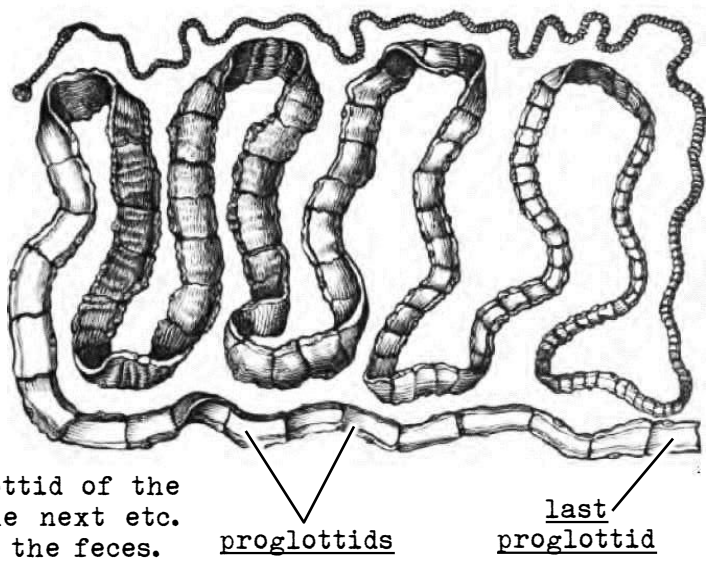
thyroxine



2) THEY ARE INFECTED BY TAPEWORMS. Imagine a 15 meter long creature living inside of your intestines. It is blind and legless, but it has a big appetite and can feed its appetite easily by absorbing nutrients directly across the entire surface of its body through its skin. Since it does not have a digestive system, it requires a supply of predigested food. The human intestine is the perfect place to lie in wait for this bounty. As you provide this food to the tapeworm, it grows bigger and eventually reproduces within you while you starve from having your nutrients stolen.



Though the head of the tapeworm does not have a mouth, it does feature a scolex which contains a fearsome ring of hooks called a rostellum, and four suckers to anchor it to the wall of the intestines. These structures are necessary to prevent the tapeworm from being swept out of the digestive tract when food and feces passes along the tract.



What might be more disturbing than how tapeworms absorb nutrients and attach to their host, is how they reproduce. Each segment of the worm is called a proglottid and each contains both male and female reproductive organs. Each segment can self-fertilize and produce eggs. As these eggs mature, the last proglottid of the tapeworm starts to fall off, then the next etc. The proglottids and eggs pass out with the feces.

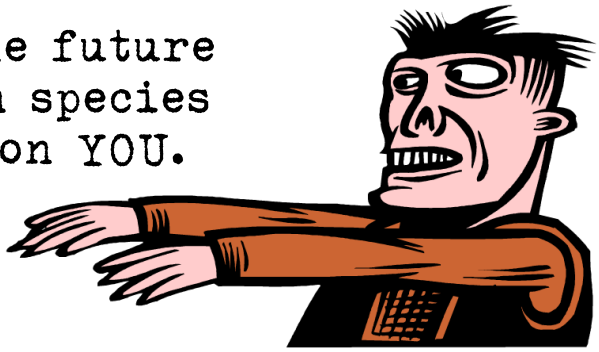
Can we get even more disturbing than that? Well, let's give it a try. How about this? How do people get infected by tapeworms to begin with? Hmmm....where did those tapeworm eggs go again? Oh yes! Out with the feces. Now how the heck did they get into people? Yes...you guessed it: feces contaminated food or drinking water. Hey, things happen.

If you're a zombie, you're not that concerned about your personal hygiene so you might also not be that picky about the state of your food when you eat it. You no longer cook or refrigerate food, so a little tapeworm infected feces mixed in with your brainlicous meal probably doesn't bother you much. It's a classic yum-yuck scenario.

ARE YOU READY FOR THE APOCALYPSE?

When the time comes and humanity faces its biggest threat, will you be prepared? You now know how zombies spread their contagion, how they think (so to speak) and why they might have a never ending desire to eat brains. You might also be able to empathize with them a little better now that you understand the possible neurological basis of some of their inappropriate and rude behaviors. This is good. The more you know about your enemy, the closer you will be to defeating it.

Good luck, the future of the human species may depend on YOU.



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Date: _____

THE SCIENCE OF ZOMBIES

Zombie Apocalypse Survival Chart

If you find yourself in the middle of a zombie apocalypse and you only have time to retrieve 3 items from a major shopping mall before the whole mall gets infested by zombies, what 3 items would you choose to help you fight the zombies and stay alive? Think about what you've learned about zombies. Use evidence from the article to support the usefulness of this item. Think creatively; your life might depend on it.

Item	Why will it be useful?	Provide evidence from the article that supports the usefulness of this item.
1)		
2)		
3)		

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Name: [redacted]
Date: 11/1/19

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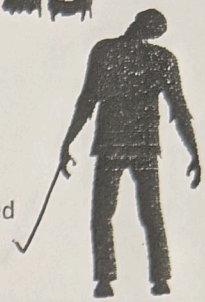
Item	Why will it be useful?	Provide evidence from the article that supports the usefulness of this item.
1) Food (canned food)	to eat	In the article I did not find food But food is necessary to survive
2) water	To Drink in order to survive	There is no evidence
3) Axe	To protect myself	no evidence its comon sense

Name: [redacted]
Date: 11/1/19

THE SCIENCE OF ZOMBIES

Zombie Apocalypse Survival Chart



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Item	Why will it be useful?	Provide evidence from the article that supports the usefulness of this item.
1) snap maps	pick people up before they get eatin or bite	"your damaged brain will cause you to exhibit violent behavior."
2) knife	to cut off their head / arms	"they have slow brains"
3) nail clippers	cut their nails so they don't stratch us	"painful bite or an an unlucky scratch"

Name: [redacted]
Date: 11/11/19

THE SCIENCE OF ZOMBIES

Zombie Apocalypse Survival Chart

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Item	Why will it be useful?	Provide evidence from the article that supports the usefulness of this item.
1) Protective equipment and face masks	To keep yourself uninfected and safe from physical and airbourne contamination	"...through invisable airbourne infection..."
2) flare gun and other weapons	for protection and if you wanted to set up a distraction	Zombies can't feel pain so it could act as a distraction
3) water guns	Zombies are afraid of water and it could be stressful	it said zombies are hydrophobic "... hydrophobia can develop..."

DNA Discovery Close Reading
Designed By: Corinne Webb, 2019

Class Analysis
Grade Level: 9th Grade
Subject: Biology

Learners	Levels/Assets	Interests/Strengths	Needs: EL (CELDT/ELPAC), IEP, 504, GATE
This lesson is designed for two periods of ninth grade Biology. Period 2 has 35 students, 10 of whom are categorized as English language learners. Two of those English language learners are new arrivals with no previous schooling. 15 of the students in Period 2 have an IEP. Period 3 has 35 students, and none of them are categorized as English language learners. 10 students in Period 3 have an IEP.	Because these students are all ninth graders, we don't have much data on their reading levels. However, during previous reading lessons, the students have struggled with organization and comprehension. Part of the objective with this lesson is to assess their abilities with regards to literacy focused assignments.	The students in Period 2 have developed a strong sense of community within their groups and seem to prefer small group instruction to whole class. Period 3 has developed a strong whole-class community and they enjoy whole class discussions, and are much more willing to share in those environments.	Period 2 is a designated ELL class, so many of those students are English language learners and two of them are new arrivals with traumatic migration experiences. Period 3 is a more typical intro Biology classroom with varying levels and 10 students with IEPs.

Support People	Technology	Supplemental Materials	Resources
This lesson is designed for small group instruction with a whole-class activity at the end.	Chromebooks, students' smartphones	DNA Discovery article, graphic organizer, pen, chromebook, large sticky sheets, post-its, markers	This video about Rosalind Franklin delves further into her role and mistreatment during the discovery, this article in Nature for GATE students

Place in Unit: Tues/Wed of week 1 in two week Biological Macromolecules Unit		
Measurable Objective: Students discuss the context of historical scientific discoveries by reflecting on the discovery of the structure of DNA in a graphic organizer and sharing at least one of their opinions with their classmates in a gallery walk.		
NGSS Standard: HS-LS1-6. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.		
Science & Engineering Practices: Scientific Knowledge Is Open to Revision in Light of New Evidence	*Disciplinary Core Ideas:* Organization for Matter and Energy Flow in Organisms	*Crosscutting Concepts:* Systems and System Models
Differentiation: *ELL* – Students can work in small groups with bilingual peers to aid in the reading activity. Students can also make use of translation apps if need be. Students can underline words they need help defining and ask the instructor as well. *IEP* – Extended time can be given on the assignment, as well as individualized attention during the small group portion of the lesson. *GATE* – This article (Nature, "*Discovery of DNA Helix: Watson and Crick*") can be given to students who finish early to read and summarize for extra credit.		

Lesson Segment	Materials	Sequence of Lesson	Instructional Strategies	Inclusive Practice to Support All Learners
Anticipatory Set (10 min)	Smartboard, pen, paper	Instructor will start with the topic of DNA in the form of a warm-up. The instructor will ask, "Take 2 minutes and write down everything you know about DNA. Keep in mind things you've learned in previous classes or TV." Then, students will share some of their responses and the teacher will write down common ones on the board, asking probing questions as appropriate.	Some questions could be: "Who discovered DNA?" "Do you think the scientists who discovered DNA had help?" "What is the structure of DNA? How do you know?" "Have you heard of Rosalind Franklin?"	Common responses will be written on the board to help students follow along, guiding questions are asked in order to model behavior

Instruction (20 min)	DNA Discovery article, graphic organizer	Instructor will break students into groups of 3-4 and give them the article and the accompanying graphic organizer. Instructor can explain, "Today we are going to be reading a scientific article about how the structure of DNA was discovered, and filling out a graphic organizer to help with reading the article analytically. We want to be sure to focus on the main idea, or the concept that the article is primarily communicating to us."	Instructor is working to frontload vocabulary related to the reading, which is supportive of ELL students. Activating students prior knowledge of DNA and focusing them on the main idea is helpful in creating shared expectations for the task.	Groups can be mindfully made to ensure bilingual peer presence for ELL students, and to ensure that heterogeneous student groups are represented, information is communicated clearly and expectations are set so the students know what to look for in the article
Guided Practice (14 min)	DNA Discovery article, graphic organizer	Instructor can go through the first paragraph of the article and practice gleaning the important points from the text with the students. Then, the instructor will build a sentence with the class's help about the main idea of the selected paragraph	The instructor models the correct usage of textual evidence and summarization, aiding the students in building connections.	Modeling for students and being clear about each step helps students to follow along, the steps will be clearly written using the SmartBoard or the document camera
Independent Practice (50 min)	DNA Discovery article, graphic organizer, large sticky sheet, post its, markers	Students are to read the rest of the article and fill out the organizer with their thoughts about the main ideas. They can annotate the article or write on it in whatever way is helpful to them. During this period the instructor will walk around and answer/ask any appropriate questions. At the end of the allotted time, the instructor will come by and check that their graphic organizers have been completed. One group will be chosen to share what they thought the main idea was and why, using evidence from the text. The rest of the class will signal whether they agree or disagree	The graphic organizer is designed to aid students in organizing their thinking, and to help in retaining and constructing information gleaned from the article. The four-corners activity helps all students have a chance to respond to a query in a non-threatening way. The post its are also anonymous, meaning that a student may feel more inclined to share their	The graphic organizer and the post-its help to ensure that everyone feels prepared and welcomed to share their thoughts, frontloading necessary vocabulary helps ELL students, instructor monitors the pacing of the activity, small group setting to maximize student learning

		with what was shared. Then, the instructor will take out large sheets of sticky paper and put them at four different tables. The sheets will have these questions: - "Do you think Rosalind Franklin was fairly treated during this scientific process?" - "How has this discovery impacted science, in your opinion?" - "Do you think Watson & Crick should receive all of the credit for this discovery, or should other scientists such as Maurice Wilkins be credited as well?" - "What challenges did Watson & Crick run into during this process?" The students will walk to each of the four stations and record their thoughts on a post it, and put it on the large sheet. They can also respond to other students' post-its with their reactions. They will be required to write at least one post-it and respond at least one time to another student.	thoughts.	
Closure (6 min)	DNA Discovery article, graphic organizer, large sticky sheet, post its, markers	The students at each of the four stations will share the general consensus of the post-its at their sheet, as well as any personal reactions they had. The students will turn in their article and graphic organizer, stapled, as their formative assessment for this unit. The post-it notes also help the instructor to gauge students' thoughts about the article.		Low pressure sharing environment ensures most people feel comfortable to share, student revisions ensures engagement, post-its help the students communicate better with each other and with the instructor

Three English Biochemists Unravel DNA to Unlock the Mystery of Life

By Cynthia Stokes Brown, Big History Project, adapted by Newsela staff on 07.30.16
Word Count **1,225**
Level **1060L**

James Watson and Francis Crick in 1959 Big History Project

In 1953, three English biochemists helped unlock the mystery of life by determining the structure of the DNA molecule. Found in all life on Earth, DNA contains the information by which an organism regenerates its cells and passes traits to its offspring.

Charles Darwin had successfully proposed the theory of natural selection, but he didn't understand how parents pass characteristics to their offspring. Slight changes when passing down traits made evolution possible.

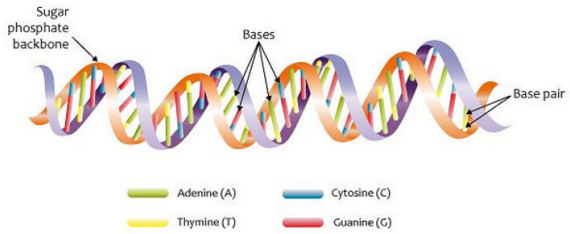
By the middle of the twentieth century, this was still not well understood. There were major breakthroughs earlier in the century in physics, such as Albert Einstein's Theory of Relativity, and atomic bombs that used nuclear fusion.

After World War II, scientists began trying to understand the physical basis (atomic and molecular) of biology. In the 1950s, biochemists realized that DNA delivered the instructions for

copying a new organism. A yard of DNA — deoxyribonucleic acid — is folded and packed into the nucleus of every cell in pairs called "chromosomes."

The parts of DNA

DNA has three parts: a type of sugar called "deoxyribose," a phosphate responsible for its acidity, and four kinds of bases — adenine (A), thymine (T), guanine (G), and cytosine (C).



These four bases seemed too simple to pass on all the information needed to create a new organism. Biochemists didn't understand DNA's structure and how it worked. However, these four bases combine like letters of an alphabet to describe complex variations in genetic traits.

The question became how to study the DNA molecule. Biochemists wanted to understand its structure. They thought this was the key to understanding how it coded the instructions for copying a new organism.

They began taking X-ray images of crystals of DNA, believing that its crystallization meant it must have a regular structure. The pattern of the X-rays bouncing off atoms gave information about their location in the molecule.

One of the pioneers of this technique, called "X-ray crystallography," was Linus Pauling, who worked at the California Institute of Technology, in Pasadena. In the early 1950s, Pauling, a prominent chemist, seemed likely to unlock the mystery of life, since he had already concluded that the general shape of DNA must be a helix, or spiral.

The race is on

The victory, however, went to three people working in England, in one of the great scientific races of all time. One, Rosalind Franklin, was working at the University of London. The other two, James Watson and Francis Crick, were friends and lab mates some 50 miles away at Cambridge University, where they worked cooperatively and shared their ideas.

Franklin was from a wealthy, influential family in London. After earning a PhD from Cambridge in physical chemistry, she began to study DNA at the University of London, in 1951. Franklin became extremely skilled in X-ray crystallography. She was able to produce clear and accurate images of DNA crystals by using fine-focus X-ray equipment and pure DNA samples.

Over at Cambridge, Crick was 35, working on his PhD in the crystallography of proteins. He had grown up in a small English village.

Watson was only 23 in 1951. He had grown up in Chicago, performed on the national radio show "Whiz Kids," entered the University of Chicago at age 15, and secured his doctorate from the University of Indiana at just 22. He was at the Cambridge lab to learn crystallography.

Between 1951 and 1953, Franklin examined her precise X-ray diffraction images. She reasoned that 1) DNA takes two forms (shorter-dryer and longer-wetter), 2) the sugar-phosphate backbones must be on the outside, and 3) the molecule looks the same upside down or right side up.

In late 1952, she recorded an especially clear X-ray image. Her colleague, Maurice Wilkins, showed the image to Watson in 1953 without telling her or asking her permission.

A spiral shape

When Watson saw the image, he knew at once that DNA had to be a helix. He returned to his lab to begin making models out of sheet metal and wire.

Watson and Crick built models to try to visualize DNA. How many strands did the helix have? Which direction did the strands run? Were they on the inside or the outside? How were the four chemical bases arranged?

Franklin believed more X-ray images of better quality would answer the questions. But Watson and Crick knew they were racing against Pauling. They felt making models would speed up the answers.

Using paper models and combining them in different ways, they visualized a structure that solved the puzzle. If two of the bases were bonded in pairs (G with C), they took up the same space as the other pair (A with T). Hence, they could be arranged like steps on a spiral staircase inside of two strands of sugar-phosphates running in opposite directions.

These insights occurred to Crick and Watson in February 1953. They announced at lunch in their usual pub that they had found the secret of life.

The news gets out

The April 25, 1953, issue of *Nature* published Crick and Watson's article, "A Structure for Deoxyribose Nucleic Acid." Wilkins and Franklin, who both accepted Crick and Watson's solution, wrote accompanying articles.

By the 1960s, scientists had accepted the double helix as the structure of DNA. In 1962, Wilkins, Watson, and Crick received the Nobel Prize in medicine/physiology for their work.

Franklin could not share in the prize. She had passed away in 1958 of ovarian cancer. She was just 37. Franklin had a family history of cancer, but her exposure to X-rays may have contributed to her death.

In any case, she may not have had the chance for the award had she been alive. Crick and Watson never told Franklin that they had used her images. In *Nature*, Watson and Crick only mentioned her briefly. She wasn't credited in Watson's book about the discovery, *The Double Helix* (1968).

It wasn't until much later that Watson finally admitted in public that he and Crick could not have found the double helix in 1953 without Franklin's experimental work. If she had survived, would she have been acknowledged and shared in the prize?

In their 1953 article, Watson and Crick did not discuss how DNA copies itself.

Five weeks after their first article in *Nature*, Crick and Watson published another article proposing the idea that, to make a copy, the double helix unzips, or separates, into two strands. Each strand

is a backbone of sugar-phosphates with the four bases attached in some sequence.

Then the cell uses each strand as a template to assemble another DNA strand from free-floating complementary bases: A picks up T, while C picks up G. This would result in two identical DNA molecules, one a copy of the other. Occasional mistakes in copying enable evolution to occur and each organism to be unique. This idea has been confirmed, while the means for carrying it out have proved to be quite complex.

Crick continued his research in England until 1976, when he moved to the Salk Institute for Biological Studies in California, where he died in 2004. Watson returned to the United States, researching at Harvard from 1956 to 1976. He helped establish the Human Genome Project in the early 1990s and served as president of the Cold Spring Harbor Laboratory in New York, until his retirement in 2007.

Name: _____
Period: _____
Date: _____

Graphic Organizer for DNA Discovery Article

What (main idea):

Who:	**Where:**	**When:**	**How:**

Why (is this important):

Macromolecule Menu UDL Lesson Plan
Designed By: Corinne Webb, 2019

Class Analysis
Grade Level: 9th grade
Subject: Biology

Learners	Levels/Assets	Interests/Strengths	Needs: EL (CELDT/ELPAC), IEP, 504, GATE
This lesson is designed for two periods of ninth grade Biology. Period 2 has 35 students, 10 of whom are categorized as English language learners. Two of those English language learners are new arrivals with no previous schooling. 15 of the students in Period 2 have an IEP. Period 3 has 35 students, and none of them are categorized as English language learners. 10 students in Period 3 have an IEP.	Because these students are all ninth graders, we don't have much data on their reading levels. However, during previous reading lessons, the students have struggled with organization and comprehension. Part of the objective with this lesson is to assess their abilities with regards to literacy focused assignments.	The students in Period 2 have developed a strong sense of community within their groups and seem to prefer small group instruction to whole class. Period 3 has developed a strong whole-class community and they enjoy whole class discussions, and are much more willing to share in those environments.	Period 2 is a designated ELL class, so many of those students are English language learners and two of them are new arrivals with traumatic migration experiences. Period 3 is a more typical intro Biology classroom with varying levels and 10 students with IEPs.

Support People	Technology	Supplemental Materials	Resources
This lesson is designed for small group instruction, with a whole class discussion at the beginning	Chromebooks, smartphones	Macromolecule Menu graphic organizer	This video (*Biomolecules*, Amoeba Sisters) can be used for more explanation of biological macromolecules and their functions, This video (*Fit Facts*, Johns Hopkins) can be used for more information about nutrition specifically if students are struggling when creating their menu, This article (*Why Do We*

			Need Fats, Carbohydrates, and Proteins in our Diet?, Lions Talk Science) can be used to provide more information about a healthy diet

Place in Unit: Mon/Tues/Wed of Week Two in Two Week Macromolecule Unit
Measurable Objective: Students build an argument to justify their choice of food for their school lunch by constructing at least one logically sound claim-evidence-reasoning passage to explain one of their choices.
CCSS Standard: CCSS.ELA-LITERACY.RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

Lesson Segment	Materials	Sequence of Lesson	Instructional Strategies	Inclusive Practice to Support All Learners
Engagement (10 min)	Smartboard, pens, paper	Show images of fruit snacks - do you think this is a healthy snack? Why or why not? What do you think constitutes a healthy snack? What makes something healthy or unhealthy? Introduce energy over time graph and ask students what they think it means for the foods we eat. Have students do a quick write and then a think-pair-share about what they wrote	Warm up quick write addressing misconceptions students may have about metabolism helps to engage them using their funds of knowledge about the subject	Think-pair-share ensures everybody has a chance to share their thoughts to a peer before sharing with the class, pictures help to engage ELL students
Exploration (30 min)	Macromolecule Menu graphic organizer, Chromebooks, smartphones, pens	Hand out instructions, students will complete the first part of the packer which has them find eight nutrition labels online and transcribe their carbohydrate, protein, and fat	Graphic organizer/problem set helps students organize themselves and the information they'll need	Small group instruction ensures optimal student-teacher interaction, front-loading vocabulary also helps students have a point of reference for the

		content. Students will then complete a graphic organizer on macromolecules and nutrition before starting to assemble their school lunch menu.	to create their menu	more independent activity later
Explanation (50 min)	Macromolecule Menu graphic organizer, Chromebooks, smartphones, paper, markers/crayons, scissors, glue	Students will start making their lunch menu and choosing the foods to include. How will students choose which foods are healthy and should be included in their lunch menu? Question students about their food choices and provide guidance in regards to the energy release graph located in the graphic organizer and how that should influence their menu choices.	Probing questions help the instructor pinpoint where students may be struggling with constructing knowledge	Small group instruction ensures optimal student-teacher interaction, instructor is able to differentiate instruction using more elaborate methods for individual students
Elaboration (50 min)	Macromolecule Menu graphic organizer, Chromebooks, smartphones, paper, markers/crayons, scissors, glue	Students should have arrived at the conclusion that protein and fats provide more sustained energy than carbohydrates, and should make up a decent part of their menu in order to provide students with the needed energy to complete their school day. Students will continue to complete their menus and start their Claim-Evidence-Reasoning paragraph about one of the foods that they chose.	Scaffolding the creation of the paragraph using sentence starters helps students to accomplish the lesson objective	Small group instruction ensures optimal student-teacher interaction, instructor is able to differentiate instruction using more elaborate methods for individual students
Evaluation (10 min)	Macromolecule Menu graphic organizer, Chromebooks, smartphones, paper, markers/crayons, scissors, glue	The accuracy and design of the menu and the claim-evidence-reasoning paragraph will used as the formative assessment for the lesson. The menu can be discussed individually with the student as part of the lesson in order to better inform the student of	Individual assessment with feedback helps students to understand where they may need improvement	Small group instruction ensures optimal student-teacher interaction, instructor is able to differentiate instruction using more elaborate methods for individual students, individual assessment allows the instructor

		how they could improve if improvement is needed.		to pinpoint exactly where each student needs improvement or is excelling

Name: _____
Period: _____
Date: _____

Metabolism, Macromolecules, & the Optimal School Lunch

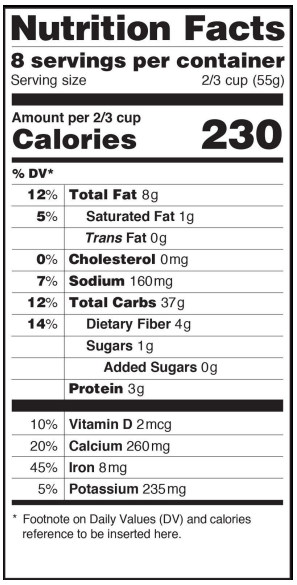
1) What are the four types of biological macromolecules?

   A.

   B.

   C.

   D.



Nutrition Facts

8 servings per container

Serving size 2/3 cup (55g)

Amount per 2/3 cup

Calories 230

% DV*	
12%	**Total Fat** 8g
5%	Saturated Fat 1g
	Trans Fat 0g
0%	**Cholesterol** 0mg
7%	**Sodium** 160mg
12%	**Total Carbs** 37g
14%	Dietary Fiber 4g
	Sugars 1g
	Added Sugars 0g
	Protein 3g
10%	**Vitamin D** 2mcg
20%	**Calcium** 260mg
45%	**Iron** 8mg
5%	**Potassium** 235mg

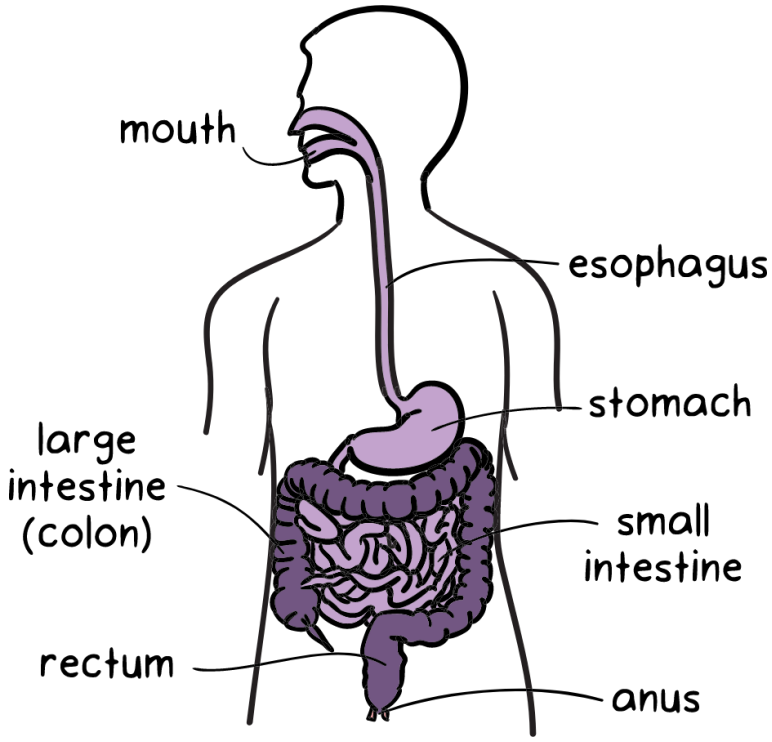
* Footnote on Daily Values (DV) and calories reference to be inserted here.

2) Using the internet, look up the food labels for <u>eight</u> different foods that you would eat.

3) Record in the data table below the total amount in **grams** of <u>fat (lipids)</u>, <u>carbohydrates</u>, and <u>protein</u> in <u>each of the eight foods</u>.

Data table:

Name of Food	Total Carbohydrates	Total Fat	Protein	Total Calories
	g	g	g	cal
	g	g	g	cal
	g	g	g	cal
	g	g	g	cal
	g	g	g	cal
	g	g	g	cal
	g	g	g	cal
	g	g	g	cal



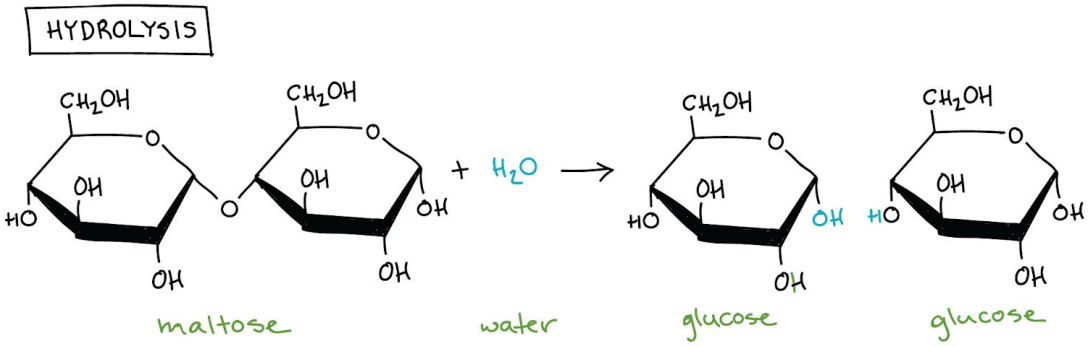
Your digestive system will break down the polymers in the food you eat into smaller molecules called monomers using a process called hydrolysis.

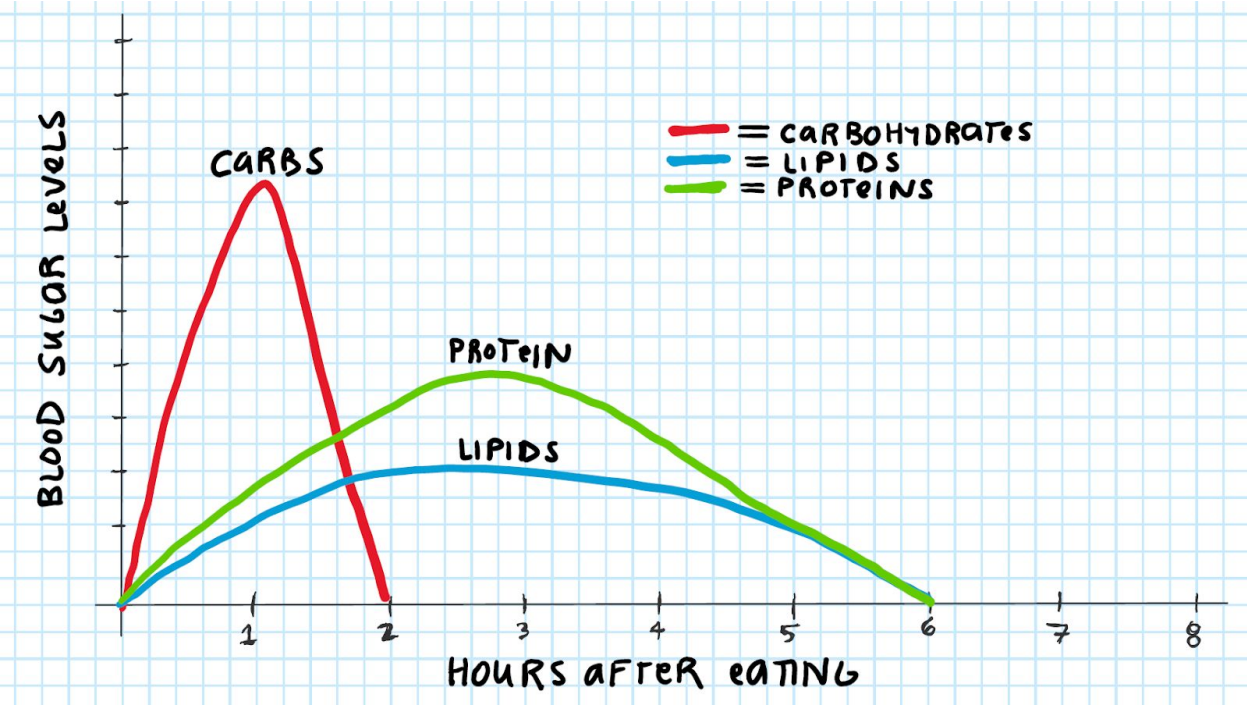
4) What is the monomer of a carbohydrate? _____

5) What is the monomer of a protein? _____

6) The process of breaking down a larger molecule, called a polymer, into its monomer is called _____ .

7) Draw, circle, and label the diagram below using the following vocab: polymer, monomer





Notice in the graph that both lipids (fats) and proteins can increase blood sugar levels but fat and proteins are not made out of sugars. It makes sense that carbohydrates are broken down into sugars, but not fat or proteins. Your body uses enzymes to convert monomers of proteins (amino acids) into glucose.

8) What type of biomolecule is an enzyme?

_____

9) What trends do you notice about carbohydrates in the graph above?

_____

_____

10) What trends do you notice about proteins and fats in the graph above?

_____

_____

Fat is an important and necessary energy source for our bodies, but fat can also clog our arteries (blood vessels) and cause a heart attack or stroke if eaten in large quantities over time. The fatty acids and cholesterol can attach to the sides of blood vessels, especially when they are inflamed, and cause a blood clot.

11) In your opinion, what would a healthy meal look like in terms of biological macromolecules? Would it be mostly carbohydrates, proteins, or fats? Would it be a little bit of each? Why?

_____

_____

_____

_____

Created by Berkah Icon from Noun Project

Designing the Optimal School Lunch

You'll have to design a menu that is nutritious and minimizes large fluctuations in blood sugar. You'll fill out the table below with your food's nutrition information, and <u>then design a menu to showcase your choices.</u> ***If you eat more than one serving, then you will need to multiply by the number of servings for the grams of carbohydrates, fats, proteins, and calories for that food.***

Type of Food	Carbohydrates	Fats	Proteins	Calories
	g	g	g	cal
	g	g	g	cal
	g	g	g	cal
Number of servings:	Multiply each by the # of servings			
Total	g	g	g	cal

Creating Your Menu Illustration & Justifying Your Choices

Your menu illustration should showcase the food items you picked with some kind of <u>creative representation</u> - it could be a drawing, a picture, or anything else you feel represents the food you chose. It <u>should include information about the food item's macromolecule makeup</u>. You can do this illustration digitally or physically.

12) Write a Claim Evidence Reasoning three sentence paragraph. This paragraph will be about one of the foods you chose above and explain why you chose that food using information from page 4. Fill in the paragraph using the sentence frames.

I claim that _____ would be part of an ideal lunch for school. The evidence to support my claim is that this food has _____ number of grams of _____ and has _____ number of grams of _____. The reason why I chose that food is that _____

_____

_____

_____

_____.